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Muresan, Ioana Stefania; Frumosu, Flavia Dalia; Khan, Shfaqat Abbas

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Muresan, I. S., Frumosu, F. D., & Khan, S. A. (2012). *The crustal uplift determined at the Jakobshavn glacier (West Greenland) using ATM and GPS data*. Abstract from Grøn dyst 2012, Kgs. Lyngby, Denmark.

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The crustal uplift determined at the Jakobshavn glacier (West Greenland) using ATM and GPS data

I. S. Muresan¹, F.D. Frumosu¹, and S.A. Khan²

¹DTU IMM, Technical University of Denmark

²DTU Space, Technical University of Denmark

The Greenland ice sheet has experienced record melting in recent years. In order to estimate the ice loss we can make use of the earth's natural elasticity to weigh the ice. Ice bends down the bedrock so when the ice melts away, the bedrock rises measurably in response. Throughout this abstract we present both a predicted and observed crustal uplift for the Jakobshavn glacier using ATM data (Airborne Topographic Mapper) from NASA ATM flights during 1997, 2005 and 2010 supplemented with data provided from continuous Global Positioning System (GPS), measurements made on bedrock between 2005-2010.

In order to compute the crustal uplift in response to the ice mass loss of the Jakobshavn area from the GPS stations, the convolution of the gridded thinning rates has been computed with the vertical-displacement Green's function as described in [1].

Several manipulations of data were required in order to achieve a good prediction of the crustal uplift. In this sense the programs Matlab and Geogrid-Gravsoft were used along with some Fortran executable files. Furthermore, the GPS data which presents the difference in uplift is provided processed as a difference of data from the permanent GPS stations KAGA, ILUL and QEKE relative to the AASI station (Figure 1). Also, in order to compare the predicted uplift from ATM data with the observed uplift from GPS data the post-glacial rebound (PGR) rates have been subtracted.



Figure 1. Greenland GPS permanent stations

The results obtained for the predicted crustal uplift for KAAS is 11.62 mm/yr while the observed value was 16.321 mm/yr, for ILAS 1.74 mm/yr and 1.53 mm/yr, for QEAS -0.189 mm/yr and 1.15 mm/yr. That being a difference of 4.701 mm/yr is found for KAAS, 0.21 mm/yr for ILAS and 1.339 mm/yr for QEAS. The uncertainties associated both with the ATM and GPS results are 0.8 mm/yr for ATM and 0.5 mm/yr for GPS. The total ice mass loss in km³ of water predicted from the ATM data concerning the Jakobshavn area is -88.815 between 2010 and 2005 and -83.599 between 2005 and 1997.

It seems fair to state that this differences, between the predicted and observed rates, may also be due to the fact that not all the errors have been taken into account when computing the observed results and also due to the fact that, perhaps, ice is melting in Greenland much faster than predicted.

REFERENCES

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